

valley, 80.9; Lower Missouri valley, 76.8; Northern Pacific region, 86.1; Central Pacific coast region, 83.9; Southern Pacific coast region, 83.9. There were 20 omissions to predict out of 3,790, or 0.54 per cent. Of the 3,670 predictions that have been made, 89, or 2.42 per cent, are considered to have entirely failed; 169, or 4.60 per cent, were one-fourth verified; 544, or 14.82 per cent, were one-half verified; 647, or 17.63 per cent, were three-fourths verified; 2,221, or 62.51 per cent, were fully verified, so far as can be ascertained from the tri-daily weather maps.

**Cautionary Signals.**—292 Cautionary Signals were displayed during the month, of which 254, or 87.0 per cent., were justified by winds of 25 miles per hour or over at, or within a radius of 100 miles of the station. 104 Off-shore Signals were displayed, of which 91, or 87.5 per cent, were fully justified; 96, or 92.3 per cent, were justified as to velocity; 94, or 90.4 per cent as to direction; and 5, or 4.8 per cent, were not justified either as to direction or velocity. 45 of the Off-shore were changed from Cautionary. 396 Signals of both kinds were displayed, of which 345, or 87.1 per cent, were fully justified. The above does not include signals ordered for 50 display stations, where the velocity is only estimated. 89 cases of winds of 25 miles and over per hour, from scattering stations, were reported, and for which signals had not been ordered.

## NAVIGATION.

In the table on the right-hand side of chart No. III are given the highest and lowest readings of the Signal Service river gauges for the month, with the dates of the same. The *Red River* at Shreveport fell slowly throughout the month. The *Arkansas* at Little Rock remained comparatively low throughout the month, the highest water occurring on the 9th; at Fort Gibson on the 3rd Grand River was higher than for 2 years past. In the *Missouri* the highest water occurred at Omaha on the 6th and Leavenworth on the 7th; the water fell about 7 feet at former and 5 feet at latter station during the following week, and remained almost stationary to end of month. The *Mississippi* from St. Paul to Keokuk had its lowest water on the 1st, after which it rose somewhat, but did not present any very high water throughout the month; the observer at Dubuque, however, reports the water on the 17th and 18th the highest since 1875; at Cairo the water fell from the 1st to the 16th; remained almost stationary to the 29th, when a rapid rise set in from the Ohio; at Memphis it fell throughout the month; at Vicksburg and New Orleans the water continued very high and above the danger-line throughout the entire month and much damage occurred, which is noted under "Floods." The *Ohio* at Pittsburgh, Cincinnati and Louisville fell slowly from 1st to 23d or 24th; after which a rapid rise occurred, reaching the maximum at Pittsburgh on the 27th, Cincinnati on the 29th and Louisville on the 30th. The *Cumberland* at Nashville generally fell until the 15th, rose to its highest point by the 20th and fell to end. The *Tennessee* at Chattanooga had the highest water on the 5th, fell to the 15th and after a slight rise remained almost stationary to end.

**Ice in River and Harbor, &c.**—The following notes on the breaking up of ice and opening of navigation are reported by observers: *Missouri*.—Ft. Hale, Dak., 9th, first steamboat. Omaha, 5th, navigation opened; 23rd, first steamer up. Leavenworth, 6th, first steamer. *Mississippi*.—St. Paul, 14th, first steamboat arrived. *Red River of the North*.—Pembina, 16th, ice moved, and on 23rd went out and navigation opened. 27th, first steamboat. *Lake Superior*.—Duluth, 15th, ice broke up in lake, but on 22nd the harbor was again filled with ice. Marquette, 11th, ice broke around docks; steamers and barges arrived on the 28th. *Lake Michigan*.—Escanaba, 13th, the first steamers broke their way through the ice. *Lake Huron*.—On the 6th the first fleet of vessels coming through Makinac straits arrived at Port Huron. *Erie Canal*.—opened at Rochester on the 17th, and Albany on the 19th. At Buffalo canal navigation opened on the 20th. *Otsego Lake*.—Cooperstown, 7th, lake open. *Lake Champlain*.—Burlington, floating ice in lake and harbor to the 8th. *Kennebec River*.—Gardiner, Me., open on 3rd, first steamer on 5th. Closed 110 days. *Lake Massabesie*.—Auburn, N. H., 9th, free of ice.

**High Tides.**—Baltimore, 30th, very high. At Buffalo, N. Y., on the 10th, the water in Lake Erie rose 6 feet, and was higher than for 20 years past.

**Low Tides.**—New River, N. C., 15th, very low.

## TEMPERATURE OF WATER.

The temperature of water as observed in rivers and harbors, with average depth at which observations were taken, is given in the table on the left-hand side of chart No. II. At the following stations observations were not made, either on account of ice or loss of thermometer, on the dates indicated: Alpena, 1st to 15th; Escanaba, 1st to 19th; Marquette, 1st to 10th, 16th and 17th; San Francisco, 2nd to 30th. Lake too rough for observation at Cleveland, 10th and 11th. At Chincoteague, Va., observations were commenced on the 14th. The March temperatures for Punta Rasa are: Max., 80°; min., 68°; average depth, 13 feet.

## ATMOSPHERIC ELECTRICITY.

**Thunder-storms** were of remarkable frequency during the month, but lack of space prevents their enumeration in detail.

**Auroras.**—During April, 1880, two general displays occurred—on the 1st and 28th, in each case extending from Eastport, Maine to Bismarck, Dakota; New Haven was the most southerly station reporting on either date. On the 1st the display generally prevailed from 9 p. m., Washington mean time, till after midnight. Eastport, Me., bright yellow; arch, 40° altitude. Grafton, N. H., faint white. Windsor, Vt., faint diffuse light, changing to arch 18° high, with segment. Burlington, Vt., bright diffuse arch of light,